PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Boaz KENAN, et al.

Appln. No.: 09/851,779

Confirmation No.: 4385

Filed: May 8, 2001

Docket No: CA1130

Group Art Unit: 2623

Examiner: Vikkram BALI

For: METHOD AND APPARATUS FOR RETICLE INSPECTION USING AERIAL INSPECTION

SUBMISSION OF APPEAL BRIEF

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

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Respectfully submitted,

Reg. No. 48,205

for Joseph Bach
Registration No. 37,771

SUGHRUE MION, PLLC
Telephone: (650) 625-8100
Facsimile: (650) 625-8110
MOUNTAIN VIEW OFFICE
23493
CUSTOMER NUMBER

Date: June 21, 2006

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I hereby certify that this SUBMISSION OF APPEAL BRIEF is being facsimile transmitted to the U.S. Patent and Trademark Office this 21st day of June, 2006.

Mariann Tam

PATENT APPLICATION

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Group Art Unit: 2623

Examiner: Vikkram BALI

For: METHOD AND APPARATUS FOR RETICLE INSPECTION USING AERIAL INSPECTION

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

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I. REAL PARTY IN INTEREST

The real party in interest is assignee, Applied Materials, Inc. The assignment was previously submitted and was recorded on July 23, 2001 at Reel 011773 Frame 0405 in parent application 09/417,518.

II. RELATED APPEALS AND INTERFERENCES

To the knowledge and belief of Appellant, the Assignee, and the Appellant's legal representative, there are no other appeals or interferences before the Board of Appeals and Interferences that will directly affect or be affected by the Board's decision in the instant Appeal.

III. STATUS OF CLAIMS

Claims 27-57 are pending in the present application. Claims 27-29, 31-51 and 55-57 stand rejected, while claims 30 and 52-54 stand objected to.

Claims 27-39, 31, 34, and 36-40 stand rejected under 35 U.S.C. § 103 as being unpatentable over Feldman (US 4,595,289).

Claims 32-33, 35, 43-50, and 55 stand rejected under 35 U.S.C. § 103 as being unpatentable over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579).

Claims 51 and 56 stand rejected under 35 U.S.C. § 103 as being unpatentable over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579), and further in view of Feldman (US 6,124,924).

Claims 30 and 51-54 stand objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

A copy of the claims on appeal is set forth in an attached Appendix.

IV. STATUS OF AMENDMENTS

An amendment under 37 C.F.R. § 1.114(c) was submitted together with the filing of the RCE on October 6, 2005. In the Office Action dated December 21, 2005, the Examiner indicated that the amendment has been entered (top of page 2 of Office Action).

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The subject invention relates to inspection of reticles (or masks) used in the photolithography step of semiconductor fabrication process. (P1, L3-10[1]). During photolithography, a semiconductor wafer is first coated with a layer of photoresist. This photoresist layer is then exposed to illuminating light using the reticle in an optical exposure tool (also called a stepper[2]) and subsequently developed. After the development, non-exposed photoresist is removed, and the exposed photoresist produces the image of the reticle on the wafer. Thereafter, the uppermost layer of the wafer is etched and the remaining photoresist is stripped. (P1, L13-21). As can be understood, since this process is repeated many times, any defect on the reticle can drastically affect yield of the processed wafers. Therefore, reticles are routinely inspected for defects. (P2, L26 to P 3, L8).

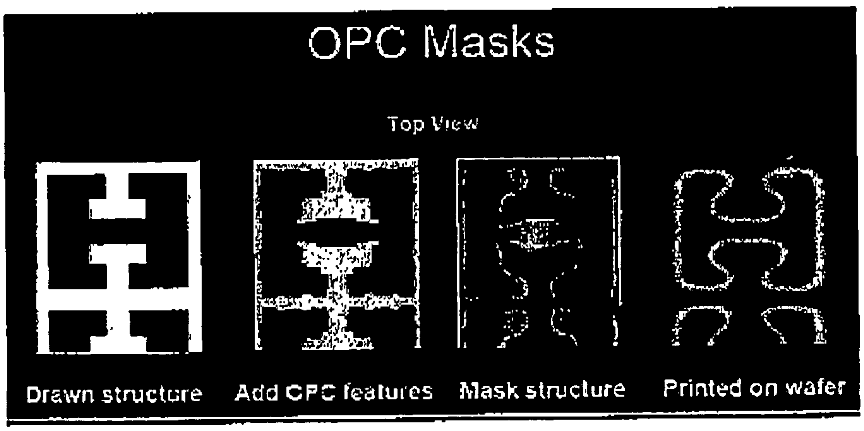
As semiconductor technology advances, feature size decreases, which leads to complications in reticle design. Some of these complications include Optical Proximity Correction (OPC) and Phase Shift Mast (PSM). (P2, L11-25). As a result, unlike prior reticles, the layout on state of the art reticles looks very different than what is ultimately sought to be printed on the wafer. Therefore, while prior art inspection systems were structured to investigate

[1] All citations in this Section refers to the subject Specification in the format (P, L), i.e., (Page, Lines).

[2] The reticle has a design of several identical dies thereupon. It is then "stepped" to make multiple imprints of these dies on the wafer. E.g., the reticle may have 4 dies and be stepped 50 times to result in 200 dies imprinted on the wafer.

the layout on the reticle, the claimed inspection system is structured to investigate the shape that would be printed on the wafer using the reticle, not the shape of the structures on the reticle.

Insert 1[3] below illustrates the various stages of reticle and wafer fabrication using OPC.



Insert 1

As can be seen from Insert 1, "Drawn structure" is the shape of the mask structure as the designer of the mask designs it and which is encoded into the database used to fabricate the mask. However, if the mask is used for advanced features, the original design would be modified to add OPC, generally an automated process using software tools. The database would then reflect the OPC change so that the design would now look like the image labled "Add OPC features." The database is then used to manufacture the reticle, which would look like the image labled "mask structure." Prior art inspection systems image the mask to obtain an image like that

[3] Insert 1 is external evidence used merely to illustrate the well known process and effect of OPC in semiconductor fabrication.

labled "Mask structure" and then compare that image to the OPC design, i.e., image labled "Add OPC features" to see whether it deviates from the design, and therefore defective. However, as shown in the image labled "Printed on wafer," the image that is actually printed on the wafer using the exposure tool varies widely from any of the other images. The claimed system is designed to obtain the printed image, such as the image labeled "printed on wafer," and from that determine whether there are any worrisome defects on the reticle.

While inspection systems examining the "as printed" image have been disclosed in the prior art, such systems compared the "as printed" image to either the design structure, or to a simulated image derived from the design structure. (P4, L9 to P5, L24). These systems provided an inadequate solution, and the claimed system was developed in view of these deficiencies. (P 5, L25 to P 6, L26). An embodiment of the claimed system is shown in Figure 1 below, which is a copy of Figure 1 of the subject Application.

As shown in Figure 1, the reticle to be inspected, 1, is placed on a moving stage, 2. The system has a laser source that provide laser radiation simulating that of an exposure tool to be used with the inspected reticle. (P10, L22-24). Various optical elements, 5, 6, 7, are used to shape the laser light to illuminate the reticle 1. Additionally, an illumination aperture, 7, is used to modify the laser beam to reproduce the illumination and the coherence condition of the exposure tool. (P11, L13-18). The light emitted from the reticle 1 is collected by the objective lens 10 and then passed through the numerical aperture diaphragm 12, the size of which is selected to reproduce the operating conditions of an exposure tool. (P11, L19-26). As can be

understood, so far all of the elements of the system are structured to basically duplicate the operation of an exposure tool, rather than an inspection tool. Consequently, the image generated by the system as so far described would be the same as that generated by an exposure tool having this reticle mounted therein. However, rather than printing the image on a photoresist-covered wafer, in the claimed invention the image is "picked up" and projected onto CCD cameras ,16-17, i.e., an aerial image of the reticle is being recorded by the CCD cameras.

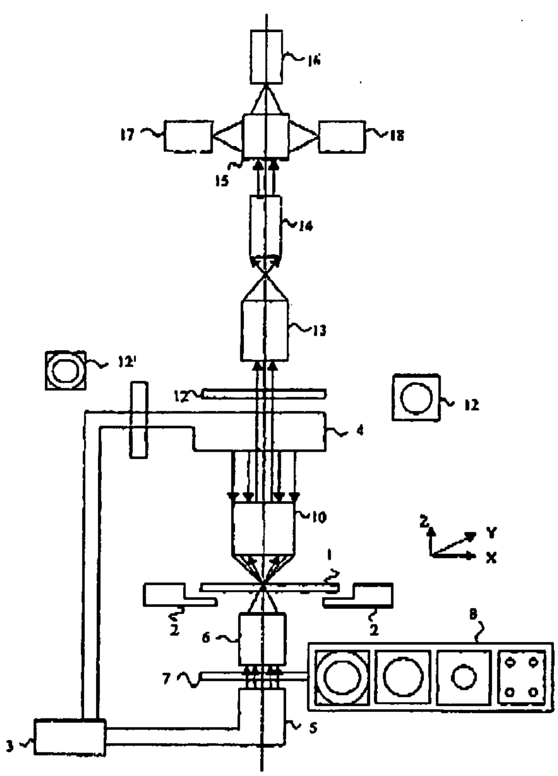


Figure 1

Once the images have been acquired, in the inventive system it is not compared to the intended image, i.e., the design image, to see whether the obtained image is the same as the expected image. Rather, the system investigates for defects by looking for line-width variations in the images obtained from two dies of the same reticle. That is, the system is based on the idea that line-width variation is indicative of a defect on the mask. To detect line-width variations the system compares several aerial images of one die of the reticle, to several images of another die of the reticle.

The inventive system is also capable of detecting particles on the reticle. To detect particles, dark-field illumination is directed at the wafer via dark-field illumination system 4. Any light diffracted by a particle is collected by the objective 10 and directed to CCD camera 16 to be detected. Figure 2 helps in understanding the function of the dark-field illumination supplementing the aerial imaging detection. As can be seen from Figure 2, when a particle is present on the glass part of the reticle, the aerial illumination is blocked and the CCD would show a dark spot - thereby indicating the presence of a particle. On the other hand, when the particle is present on the chrome area of the reticle, the aerial imaging illumination will not provide any indication of its presence, as the light is blocked by the backside of the chrome and does not reach the CCD sensor regardless of the presence of the particle. Therefore, dark-field illumination is used to detect such particles and supplement the aerial imaging inspection.

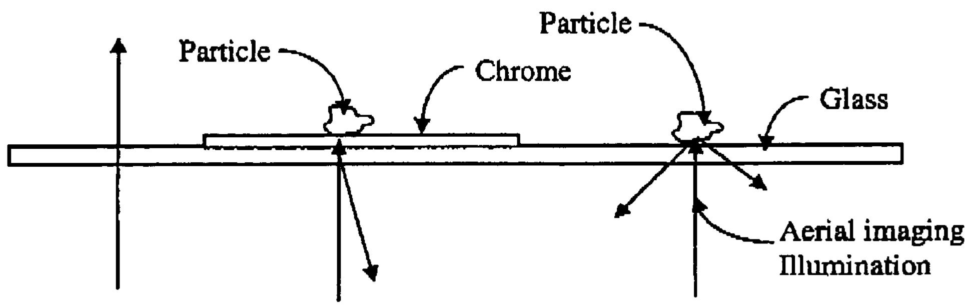

Particle
Particle
Chrome
Glass
Aerial imaging
Illumination

Figure 2

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Are claims 27-39, 31, 34, and 36-40 patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289).

2. Are claims 32-33, 35, 43-50, and 55 patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579).

3. Are claims 51 and 56 patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579), and further in view of Feldman (US 6,124,924).

VII. ARGUMENT

As an initial matter, for each ground of rejection, the claims should not be considered to stand or fall together.

i. General argument applicable to all pending issues

A bright field image is an image experience when one takes a conventional picture using a camera. In fact, using a digital camera having a CCD sensor is very much like the bright field imaging described in Elyasaf, using the light source 4 and the CCD sensor 20 (Figure 1). The bright field image generated in Feldman differs only in that the illumination is done from behind the object pictured (as when taking picture with the sun behind the person pictured). Still, it is a traditional bright field image. That is, it is an image of the object itself, in this case an image of the reticle itself. As explained in the cited references, these bright-field images of the reticle themselves are used to examine for defects in the reticles.

Dark-field imaging takes a different form than bright-field imaging. Contrary to bright-field imaging, dark-field imaging does not seek to generate an image of the article, but rather only of abnormities on the article. One experiences dark-field imaging when one looks at a ray of sunshine or a beam of an LCD illumination projector - suddenly dust particles are seen inside the ray, but none are seen outside the ray. The same is done in dark-field inspection. That is, either the illumination, or the detector, or both, are positioned such that the normal reflection of the illumination from the object will not reach the detector. Consequently, no image of the article is generated, as no reflected light reaches the detector (hence- dark field). However, if an

abnormality, such as a particle, is present on the article, the light will be scattered in all directions indiscriminately, and some of it will reach the detector. At this point, the detector will register a high intensity light and will emit a corresponding signal. The resulting image is like stars at night. In this manner, abnormalities on the article are detected without actually generating an image of the article.

Aerial imaging, on the other hand, is a very different concept from either bright-field or dark-field imaging. In aerial imaging, the system does not produce an image of the reticle itself and does not search abnormalities on the article itself. Rather, in aerial imaging the image that is generated is the image that would be produced if the reticle was to be used in an exposure system (such as a stepper) and the abnormalities that are searched are abnormalities that will appear in such an image, not abnormalities on the reticle itself. That is, while the bright-field and dark-field systems of the prior art study the physical structure of the reticle itself, the claimed aerial imaging studies the image that would be produced from the reticle, not the reticle itself. See, e.g., paragraph bridging pages 3 and 4 of the subject Specification.

This difference is highlighted in the article Pattern-Related Defects Become Subtler, Deadlier, by Alexander E. Braun, in Semiconductor International, May 1, 2005, which is attached as Exhibit A. There, Braun explains:

> "Two technologies are used for image acquisition — high numerical aperture (NA) and aerial image inspection. The first consists of a high-NA microscope that detects variations from the intended pattern. It detects transmission deviation defects, such as a mouse-bite, line edge defect or a chrome spot; however, it does not do well

with more advanced mask types, such as alternating phase-shift photomasks, where a quartz defect may exist.

Aerial image inspection mimics a wafer exposure tool and operates at a lower NA. Rather than directly imaging defects, it searches the pattern for variations from the intended CD. It is effective in detecting defects associated with phase anomalies. According to Kalk, the technique is useful for phase-shift masks. In principle, it can also verify defect printability. However, its sensitivity to the more classical defects is not as good as high-NA inspection."

A similar explanation is provided in the article The View from Above, printed in SPIE's *OE*Magazine - the foremost authority in semiconductor inspection, and attached as Exhibit B herewith.

To implement this concept, the claimed optical system is constructed so as to simulate the exposure conditions of an exposure system. Then, rather than projecting the generated image onto a wafer (as would be done in an exposure system) the image is optically picked up (from the air - thus aerial imaging) and is projected onto the CCD sensor. In this manner, the image that is generated is not an image of the reticle, but rather an image that would have been projected onto a wafer under an exposure conditions of an exposure tool. Then, the system analyzes the aerial images for defect, i.e., not the image of the reticle, but the projected aerial image.

ii. Claims 27-39, 31, 34, and 36-42[4] are patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289)

As explicitly stated in the '289 patent, the Feldman system is a combination bright-field and dark-field inspection system. See, e.g., Column 2, lines 29-31; column 8, lines 10-13, and Figure 4. There is absolutely no mention in Feldman of aerial images or of "a scanner for acquiring a plurality of aerial images" as required by all of the claims on appeal. The Examiner's statement in paper #4, Paragraph 6, that Feldman's elements 32 and 34 of Figure 4 disclose the claimed scanner acquiring a plurality of aerial images of the reticle is clearly contrary to the explicit teaching of Feldman. Feldman explicitly states that the system of Figure 4 uses bright-field and dark-field modes ("inspection system shown in FIG. 4 includes both dark-field and bright-field illumination capabilities" column 8, lines 18-20). In describing elements 32 and 34 of Figure 4, Feldman explicitly states that these are used for the bright-field portion of the system (column 5, lines 46-54). Feldman explicitly states that these are the same elements depicted in Figure 1, which is a conventional bright-field inspection system. See, column 3, lines 63-64. As explained in the subject Application, as is well known in the art, and as explained in the evidence attached as Appendix A and Appendix B, aerial image acquisition is

[4] Note: The Examiner never "formally" rejected claims 41 and 42. That is, in the pending rejection the Examiner did not rejected these claims in neither of paragraphs 3, 4, nor 5, and in paper #4 the Examiner also never indicated that these claims are rejected in neither of paragraphs 6, 7, nor 8. However, since the Examiner provides his reasoning of rejecting claims 41 and 42 in paragraph 6 of paper #4, i.e., as being obvious from Feldman '289 alone, Applicants address these rejections under this heading.

different than bright-field image acquisition and, therefore, the Examiner's reading of aerial imaging limitation on Feldman's bright-field system cannot be upheld.

Furthermore, claim 27 recites "an optical system simulating said set of exposure conditions of said optical exposure system." Feldman provides not a single hint of such a system. The Examiner's argument that this limitation is read as the "images taken by the camera using the light reflected of the masks" (Paragraph 3 of OA dated 12/21/05) cannot be supported. As stated in claim 27, the reticle that is being inspected is to be used in an exposure system under a set of exposure conditions. The claim then recites that the aerial images are taken using the same set of exposure conditions as of the exposure system. Feldman makes no reference as to the exposure conditions of the bright-field images with respect to the exposure conditions of the exposure tool. Therefore, there is absolutely no support for the Examiner's position that the images of Feldman are taken under the same set of exposure conditions. Moreover, Feldman never discloses any system that would simulate the set of exposure conditions, as required by the claim.

Claim 27 also requires "an image processing module for detecting variations in line width." However, Feldman never teaches such a processing module. Rather Feldman discloses that his system improves defect detection as it helps eliminate the false-alarms caused by relative misalignment: "relative misalignment between features in the patterns being compared also produces a difference signal." (See, column 4, lines 48- 55). Nowhere does Feldman suggests that his system is capable of detecting line width variations.

With respect to claim 34, it recites: "for moving said stage in a continuous manner." While Feldman discloses a stage, Feldman does not disclose that the stage is moved in a continuous manner. To the contrary, Feldman discloses that the stage is stepped: "After each X-direction scan, the table 12 is stepped a predetermined distance in the Y direction before the next X-direction scan is commenced. Clearly Feldman teaches to the contrary.

With respect to claim 36, the claim recites: "an image acquisition module for collecting light emerging from said reticle and creating aerial images of said reticle in said first, said second, and said third cameras." The Examiner conveniently ignored this limitation in rejecting this claim (paper #4). As already been discussed above, Feldman does not teach aerial imaging and clearly does not teach using three cameras to create aerial images of the reticle with each camera.

Additionally, claim 36 recites a dark-field illumination system in addition to the aerial imaging illumination system. While Feldman teaches a bright-field transmission illumination and a dark-field illumination, Feldman fails to teach or suggest an aerial imaging system with a dark field illumination system. That is, since Feldman uses two detectors spaced apart for imaging two corresponding areas of the reticle, Feldman focuses on the possibility of errors due to misalignment of the two detectors, as already explained. However, in the subject invention no spaced apart detectors are used. Therefore, the motivation of Feldman is inapplicable to the subject invention. Rather, the motivation for the dark field is provided by the subject application, i.e., to detect particles.

With respect to claim 37, the claim recites: "a numerical aperture diaphragm for reproducing said set of exposure conditions." The Examiner's citation to column 8, lines 35-39 of Feldman has absolutely no relevance to this limitation. In the cited passage, Feldman merely explains that his inspection resolution can be obtained using a numerical aperture of about 0.2. Feldman provides no indication as to how this numerical aperture compares to that of the lithography exposure system. Therefore, Feldman clearly fails to teach a numerical aperture selected to reproduce the set of exposure conditions of the exposure tool, as required by the claim. Moreover, the Examiner's statement that Feldman's numerical aperture "makes the exposure to match the image detectors in order to image the object" (paper 4) is irrelevant to the claim's language. The claim requires that the matching would be to that of the exposure tool, not to the detectors. Accordingly, the Examiner's position cannot be sustained.

The Examiner states that claims 41 and 42 are rejected for the same reasons as claim 27 and 36. As demonstrated above, neither rejection of claim 27 or 36 can stand. Therefore, at least for these reasons the rejections of claims 41 and 42 cannot stand either.

<u>iii. Claims 32-33, 35, 43-50, and 55 are patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579)</u>

Claim 32 recites that the "light source is a pulsating light source." The Examiner acknowledges that Feldman fails to teach such a system, but argues that since Elyasaf teaches pulsating in the same art, it can be combined with Feldman. However, the Examiner failed to provide any motivation as to why one may use the pulsating light of Elyasaf in the system of

Feldman. While Feldman states that conventional sources may be used, Feldman does not mention pulsating sources. Elyasaf, on the other hand, teaches pulsating sources for a particular purpose: to synchronize the transmitted and reflected detection using a single CCD. See, Fig. 4 of Elyasaf where it is illustrated how consecutive pulses are used for transmission and reflection detection. Feldman, on the other hand, uses different detectors for the bright field and for the dark field. Therefore, no motivation is provided to use pulsating light source of Elyasaf in the system of Feldman.

Claim 35 recites a stage moving in a continuous manner. As already discussed above, Feldman teaches clearly to the contrary.

Regarding claim 43, to begin with, as can be understood by an artisan in the art, both Feldman and Elyasaf teach bright field inspection systems, and not aerial imaging systems. Additionally, claim 43 recites: "imaging means for acquiring said plurality of magnified aerial images of said reticle." The Examiner cites column 3, line 66 to column 4, line 5, of Elyasaf as teaching the "magnified aerial images" limitation. However, nothing in the cited passage even remotely relates to this limitation. The cited passage merely teaches how the reticle is imaged in a slices manner with overlap, as shown in Figure 2 of Elyasaf. Accordingly, this rejection cannot stand.

Regarding claim 44, as explained above, the Examiner failed to provide motivation as to why a pulsating light source would be employed in the system of Feldman.

Regarding claim 46 and 47, as explained above, Feldman teaching is contrary to the claimed "means for moving said stage in a continuous manner."

Regarding claim 48 and 49, the Examiner failed to demonstrate that it would have been obvious to combine a dark field illumination in addition to aerial imaging.

Regarding claim 57, the claim recites "homogenizer disposed in the vicinity of said transmission light illumination means for reducing speckle resulting from use of said light source." The Examiner's reading of this limitation on elements 24 and 26 of Feldman is simply not sustainable. Elements 24 and 26 of Feldman are merely lenses. They do not and cannot reduce speckle as claimed.

<u>iv. Claims 51 and 56 are patentable under 35 U.S.C. § 103 over Feldman (US 4,595,289) in view of Elyasaf (US 5,892,579), and further in view of Feldman (US 6,124,924)</u>

With respect to claim 51, the claim recites three cameras, each acquiring "plurality of magnified aerial images." The Examiner read these limitations on sensors 32, 34, and 85 of Feldman. However, this reading cannot be sustained. Sensors 32 and 34 of Feldman acquire a bright-filed image of the reticle, not a magnified aerial image. Similarly, sensor 85 detects a dark-field image of the reticle, not a magnified aerial image.

Additionally, the Examiner acknowledges that Feldman '289 and Elyasaf fail to teach the limitation "the first second and third images are of transmission light illuminations means." The Examiner argues that this limitation is supplied by Feldman '924. This argument clearly cannot

stand. As can be clearly understood by artisan in the art, Feldman '924 discloses a wafer inspection apparatus using a bright-field and dark-field illumination (e.g., column 4, lines 58-62). As is known, one cannot inspect a wafer using transmitted light, as the wafer is opaque. Wafers are inspected only using reflected and scattered light. Consequently, the combination of all three references still fails to teach using 3 cameras to obtain 3 images using transmission light illuminations.

Regarding claim 56, the Examiner alleges that it is well known to use sensor of the same wavelength of the exposure and the light source. However, it seems that the Examiner missed an important point of the claim; that is, the selection is not of the exposure of the inspection system, but that of the exposure tool. That is, the wavelength of the illumination is first selected to match that used in the exposure tool (not the inspection tool), and then the sensor is selected to match that wavelength. As explained in the subject specification, this is done in order to simulate the set of conditions of the exposure tool. The Examiner provided no argument as to why this would be obvious.

Unless a check is submitted herewith for the fee required under 37 C.F.R. §41.37(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

Atty. Docket No.: 003587 USA D01/MASK/RT/OR (CA1130)
PATENT APPLICATION

APPEAL BRIEF UNDER 37 C.F.R. § 41.37
U.S. Application No.: 09/851,779

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Respectfully submitted,

Reg. No. 48,205

for Joseph Bach
Registration No. 37,771

SUGHRUE MION, PLLC
Telephone: (650) 625-8100
Facsimile: (650) 625-8110
MOUNTAIN VIEW OFFICE
23493
CUSTOMER NUMBER

Date: June 21, 2006

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this APPEAL BRIEF UNDER 37 C.F.R. § 41.37 is being facsimile transmitted to the U.S. Patent and Trademark Office this 21st day of June, 2006.

Mariann Tam

CLAIMS APPENDIX

CLAIMS 27-57 ON APPEAL:

27. An apparatus for inspecting a multiple die reticle that is used with an optical exposure system under a set of exposure conditions, said multiple die reticle including at least a first die and a second die, said apparatus comprising:

an optical system simulating said set of exposure conditions of said optical exposure system;

a scanner for acquiring a plurality of aerial images of said multiple die reticle under said set of exposure conditions; said plurality of aerial images of said reticle comprising a first plurality of aerial images of said first die and a second plurality of aerial images of said second die; and

an image processing module for detecting variations in line width of said first die of said reticle using said first plurality of aerial images of said first die and said second plurality of aerial images of said second die of said multiple die reticle.

28. The apparatus according to claim 27, wherein said scanner comprises a plurality of cameras for acquiring said plurality of aerial images of said multiple die reticle.

29. The apparatus according to claim 28, wherein said plurality of cameras comprises:

a first camera for acquiring a first image of said plurality of aerial images of said multiple die reticle;

a second camera for acquiring a second image of said plurality of aerial images of said multiple die reticle; and

a third camera for acquiring a third image of said plurality of aerial images of said multiple die reticle.

30. The apparatus according to claim 29, wherein:

said first camera is in focus;

said second camera is out of focus in a positive direction; and

said third camera is out of focus in a negative direction.

31. The apparatus according to claim 28, wherein:

said scanner further comprises a light source for illuminating said reticle with an illuminating light; and

said plurality of cameras are sensitive to said illuminating light.

32. The apparatus according to claim 31, wherein said light source is a pulsating light source.

33. The apparatus according to claim 32, wherein said pulsating light source is a pulsating laser.

34. The apparatus according to claim 27, further comprising a stage on which said reticle is placed, and means for moving said stage in a continuous manner.

35. The apparatus according to claim 32, further comprising a stage on which said reticle is placed, and means for moving said stage in a continuous manner.

36. The apparatus according to claim 29, wherein said scanner further comprises:

a transmission light illumination system for illuminating said reticle;

a dark field illumination system for illuminating said reticle; and

an image acquisition module for collecting light emerging from said reticle and creating aerial images of said reticle in said first, said second, and said third cameras.

37. The apparatus according to claim 36, wherein said optical system comprises a numerical aperture diaphragm for reproducing said set of exposure conditions.

38. The apparatus according to claim 36, wherein said dark field illumination system is positioned adjacent to said image acquisition module.

39. The apparatus according to claim 36, wherein said dark field illumination system is coaxial with said optical system.

40. The apparatus according to claim 36, wherein said dark field illumination system and said transmission light illumination system are positioned on opposite sides of said reticle.

41. An apparatus for inspecting a reticle that is used with an optical exposure system under a set of exposure conditions, said apparatus comprising:

an optical system simulating said set of exposure conditions of said optical exposure system;

a scanner for acquiring a first plurality of aerial images of said reticle in a transmitted light under said set of exposure conditions and a second plurality of dark field images of said reticle in a reflected light; and

an image processing module for detecting defects in said reticle using said first plurality of aerial images of said reticle and said second plurality of dark field images of said reticle.

42. The apparatus according to claim 41, wherein said scanner further comprises:

a transmission light illumination system for illuminating a first face of said reticle;

a dark field illumination system for illuminating a second face of said reticle; and

an imaging module for collecting light emerging from said reticle and acquiring said first and said second pluralities of aerial images of said reticle.

43. An apparatus for inspecting a multiple die reticle that is used with an optical exposure system under a set of exposure conditions, said multiple die reticle including at least a first die and a second die, said apparatus comprising:

a light source;

transmission light illumination means for illuminating said reticle;

optical means for producing a plurality of magnified aerial images of said reticle under said set of exposure conditions, said optical means having a numerical aperture diaphragm for reproducing said set of exposure conditions;

imaging means for acquiring said plurality of magnified aerial images of said reticle; said plurality of magnified aerial images of said reticle comprising a first plurality of aerial images of said first die and a second plurality of aerial images of said second die; and

image processing means for analyzing a condition of said reticle using said first plurality of aerial images of said first die and said second plurality of aerial images of said second die.

44. The apparatus according to claim 43, wherein said light source is a pulsating light source.

45. The apparatus according to claim 44, wherein said pulsating light source is a pulsating laser.

46. The apparatus according to claim 43, further comprising a stage on which said reticle is placed, and means for moving said stage in a continuous manner.

47. The apparatus according to claim 44, further comprising a stage on which said reticle is placed, and means for moving said stage in a continuous manner.

48. The apparatus according to claim 43, further comprising a dark field illumination means for illuminating said reticle.

49. The apparatus according to claim 43, wherein said transmission light illumination means and said dark field illumination means are positioned on opposite sides of said reticle.

50. The apparatus according to claim 43, wherein said imaging means further comprises a plurality of cameras for acquiring said plurality of magnified aerial images of said reticle when the reticle is illuminated by said transmission light illumination means.

51. The apparatus according to claim 50, wherein said plurality of cameras comprises:

a first camera for acquiring a first image of said plurality of magnified aerial images of said reticle;

a second camera for acquiring a second image of said plurality of magnified aerial images of said reticle; and

a third camera for acquiring a third image of said plurality of magnified aerial images of said reticle; said first, said second and said third aerial images of said reticle being respectively acquired by said first, said second and said third cameras when the reticle is illuminated by said transmission light illumination means.

52. The apparatus according to claim 51, wherein:

said first camera is in focus;

said second camera is out of focus in a positive direction; and

said third camera is out of focus in a negative direction.

53. The apparatus according to claim 52, wherein:

said first camera acquires a fourth image of said plurality of dark field images of said reticle, said fourth image being acquired when said reticle is illuminated by said dark field illumination system.

54. The apparatus according to claim 53, wherein said image processing means uses said fourth image to identify defects in said reticle.

55. The apparatus according to claim 43, further comprising a post process and review means for displaying said condition of said reticle in a graphical form.

56. The apparatus according to claim 51, wherein:

a wavelength of the light source is identical to the wavelength of the exposure system; and

said first, said second, and said third cameras are sensitive to said wavelength of said laser light source.

57. The apparatus according to claim 43, further comprising a homogenizer disposed in the vicinity of said transmission light illumination means for reducing speckle resulting from use of said light source.

EVIDENCE APPENDIX:

None.

RELATED PROCEEDINGS APPENDIX

None.